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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/811,230
Filing Date: March 26, 2004
Appellant(s): GANGULI ET AL.

Keith M. Tackett
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 23 October 2008 appealing from the Office action mailed 8 April 2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The heading of the 35 USC 103(a) rejection over Aaltonen et al. (US 2003/0165615) in view of Kawano et al. (US 6605735) for purposes of appeal will

now be Aaltonen et al. in view of Kawano et al. and in further view of the applicant's admitted prior art paragraphs 0068-0069 in the instant specification. This does not constitute a new ground of rejection as it is only added to the heading of the rejection for clarity during the appeal, and was relied upon in previous office actions to rebut arguments (see, for example, page 5 of the Final Office Action dated 4/8/2008) within this ground of rejection.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

US 2003/0165615 A1	AALTONEN et al.	09-2003
US 6,605,735 B2	KAWANO et al.	08-2003

Applicants' admitted prior art, Instant specification paragraphs 0068-0069 or page 23 lines 6-23.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 2, 4-7, 9-14, 16-17, 19-20, 22-25, 27-28, 30-33, 35-38, 40-42, 44-46, 48-51, and 53-67 are rejected under 35 U.S.C. 103(a) as being unpatentable over

Aaltonen et al. (US 2003/0165615) in view of Kawano et al. (US 6605735) and in further view of the applicant's admitted prior art (paragraphs 0068-0069 in the instant specification). **This does not constitute a new ground of rejection as it is only added to the heading of the rejection for clarity during the appeal, and was relied upon in previous office actions to rebut arguments (see, for example, page 5 of the Final Office Action dated 4/8/2008).

As to claim 1, Aaltonen et al. discloses a method of forming a ruthenium layer comprising a ruthenium layer deposited by pulsing a ruthenium precursor into a chamber and exposing it to the barrier layer and therefore chemisorbing it, and exposing the ruthenium layer to a reducing gas and reacting it to form the ruthenium layer, with purge gas pulses in between the pulses of reactant gases (paragraph 0021). Aaltonen et al. does not disclose the ruthenium precursors as required by claim 1. Kawano et al. teaches using the ruthenium compounds claimed as shown in column 3 line 39- column 4 line 57 in CVD because the compounds give the benefit of low temperature deposition and ease of supplying a precursor in gas form (column 3 lines 17-23) as the precursor cures the deficiencies of other precursors as discussed in columns 1 and 2 et seq. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Aaltonen et al. to include the precursors of Kawano et al. in order to use a precursor that gives the benefit of low temperature deposition and ease of supply. It also would have been obvious at the time of the invention to use CVD processes in an ALD process because "a person of ordinary skill

has good reason to pursue the known options with his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense." Aaltonen et al. teaches that one of ordinary skill in the art would use ALD over CVD because of improved step coverage, uniformity, and thickness control (paragraph 0007). One of ordinary skill in the art would certainly find it within their technical grasp to use a CVD precursor in an ALD process with a reasonable expectation of success, given the advantages of using ALD in Aaltonen et al. and the precursors in Kawano et al. (See *KSR International Co. v. Teleflex Inc.*, 550 U.S.--, 82 USPQ2d 1385 (2007).

Aaltonen et al. and Kawano et al. do not explicitly teach using the combination of ammonia and atomic hydrogen as a reducing agent. The applicant, however, admits that reducing agents such as ammonia, atomic hydrogen, etc. and combinations thereof are traditional reducing agents, indicating that their use is well-known and documented in the prior art (paragraph 0068 of the instant specification). Therefore, it would have been obvious to one of ordinary skill in the art to use a traditionally accepted reducing agent with the ruthenium compound, given the reasonable expectation of success provided by using a traditionally proven compound. This limitation would have been obvious because the substitution of one known element for another would have yielded predictable results to one of ordinary skill in the art at the time of the invention. (See *KSR International Co. v. Teleflex Inc.*, 550 U.S.--, 82 USPQ2d 1385 (2007).

Regarding claims 2 and 4, Kawano et al. teaches the claimed ligands in (column 3 line 39- column 4 line 57 and throughout column 9 line 29 – column 10 line 3)

Regarding claim 5, Kawano et al. discloses the reducing gas to include a nitrogen carrier gas in the examples.

Regarding claim 6, Aaltonen et al. discloses the ruthenium layer being formed at 300-360 °C (paragraph 0059).

Regarding claim 7, Aaltonen et al. discloses the ruthenium layer to be able to have a thickness of about 20 A (paragraph 0071).

As to claim 9, Aaltonen et al. discloses depositing the ruthenium over a barrier layer including those claimed in paragraphs 0063, 0066-0067, for example.

As to claim 10, Aaltonen et al. discloses a low-k material of those claimed on the substrate in paragraphs 0063-0064, for example.

Aaltonen et al. in view of Kawano et al. includes all of the provisions of claim 11, as the ruthenium precursor taught by Kawano et al. includes bis(2,4-dimethylpentadienyl)ruthenium (column 3 line 39- column 4 line 57 and throughout column 9 line 29 – column 10 line 3)

Aaltonen et al. in view of Kawano et al. disclose claims 12-14, 16-17, 19-20, 22-25, 27-28, 30-33, 35-38, 40-42, 44-46, 48-51, and 53-67 as described above.

Regarding claim 55, Aaltonen et al. in view of Kawano et al. includes all the requirements of claim 55, and additionally Aaltonen et al. discloses the ruthenium layer as a seed layer for copper deposition and being deposited overtop a barrier layer in paragraph 0006.

(10) Response to Argument

Applicant's arguments filed 23 October 2008 have been fully considered but they are not persuasive.

The applicant argues that Kawano et al. does not disclose the same compound as the applicants' for use in CVD, citing a section from the document that shows a bis(dialkylpentadienyl) ruthenium compound as a reactant to synthesize the actual precursor used to deposit the film, and is not the precursor itself. Though the Examiner substantially agrees with the applicant, Kawano et al. shows other embodiments that indeed meet the claim limitations of the specific ruthenium compounds. Compound 7 in Kawano et al., as shown in the abstract and described in column 4 lines 26-58 may be classified as one of the claimed compounds and is used when depositing the film. The applicant requires a bis(dialkylpentadienyl) ruthenium compound and Kawano et al. teaches a carbonylbis(2-methyl-1,3-pentadiene)ruthenium compound in the abstract that is classified as a bis(dialkylpentadienyl) ruthenium compound in the chemical arts, the presence of the carbonyl group does not negate that the compound is a bis(dialkylpentadienyl) ruthenium compound. For further examples, Kawano et al. teaches a variety of ruthenium compounds including more pentadienyl compounds throughout column 9 line 29 – column 10 line 3. Though the document may contain other embodiments, it does not negate that Kawano et al. does contain embodiments where the claimed compound is used in CVD as shown in the abstract and described in column 4 lines 26-58.

Further, the applicant argues that one of ordinary skill in the art would not modify Aaltonen et al. to utilize the traditional reductants in applicants' specification paragraphs 0068-0069 because it uses oxygen as a reducing gas and any other reducing gas would make Aaltonen et al. inoperable. However, in the instant specification paragraphs 0068-0069, the applicant discusses suitable reductants that include those claimed and designates them traditional reductants, but then goes on to talk about oxygen as an alternative reducing gas. This section of the instant specification (paragraph 0069) conveys the same meaning as Aaltonen et al. in the passage cited on page 15 of the brief, that oxygen is usually an oxidizing gas but is surprisingly suitable as a reductant for ruthenium compounds. Thus, other reducing gases such as the traditional reductants as admitted by the applicant would not make Aaltonen et al. inoperable because the applicant uses the oxygen precursors of Aaltonen et al. and the traditional reductants of paragraph 0068 interchangeably. Therefore, in view of paragraphs 0068-0069 of the instant specification, the claimed reducing gases are not an inventive concept. The applicant admits that reducing agents such as ammonia, atomic hydrogen, etc. and combinations thereof are traditional reducing agents, indicating that their use is well-known and documented in the prior art (paragraph 0068 of the instant specification). Therefore, it would have been obvious to one of ordinary skill in the art to use a traditionally accepted reducing agent with the ruthenium compound, given the reasonable expectation of success provided by using a traditionally proven compound. This limitation would have been obvious because the substitution of one known element for another would have yielded predictable results to one of ordinary skill in the art at the

time of the invention. (See *KSR International Co. v. Teleflex Inc.*, 550 U.S.--, 82 USPQ2d 1385 (2007).

As for the applicants' remaining arguments stating that the combination of references does not teach the limitations of the claims, the limitations of these claims are taught as discussed above. Similarly, the applicant repeats the same arguments in sections B and C in the brief and these arguments are answered as discussed above.

Therefore, for at least these reasons, the rejections of the previous office action are maintained.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Kelly M. Stouffer/
Examiner, Art Unit 1792

Conferees:

/Timothy H Meeks/

Supervisory Patent Examiner, Art Unit 1792

/Jennifer Michener/

QAS, TC1700